EPFL
ENAC TRANSP-OR
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Mathematical Modeling of Behavior
Fall 2015

EXERCISE SESSION 10: Theory and Exercises Session

Question 1
In your data file, the unit for the cost attributes (named $costKCHF_{car}$ and $costKCHF_{bus}$) is kCHF. You want to define two new attributes (named $costCHF_{car}$ and $costCHF_{bus}$) where the unit is CHF. How can you specify this in the model file?

Question 2
What is the motivation for including alternative specific constants in the utilities? Why do we have to set the constant for one of the alternatives to zero? Does it matter for which alternative we set the constant to zero?

Question 3
The results of a model that you estimated on the Netherlands mode choice data are shown below. Give an interpretation of these results.

Model:	Multinomial Logit
Number of estimated parameters:	4
Sample size:	228
Null log-likelihood:	-158.038
Init log-likelihood:	-158.038
Final log-likelihood:	-122.133
Likelihood ratio test:	71.8091
Rho-square:	0.22719
Adjusted rho-square:	0.20188
Final gradient norm:	3.01265
Variance-covariance:	from finite difference hessian

Name	Value	Std err	t-test		Robust Std err	Robust t-test	
ASC_CAR	-1.7037232e-02	+5.7689426e-01	-2.9532677e-02	*	+6.2538746e-01	-2.7242682e-02	*
B_COST_CAR	-5.7712704e-07	+1.2242850e-07	-4.7139925e+00		+1.4402280e-07	-4.0071923e+00	
B_COST_RAIL	-2.9714400e-07	+1.6658135e-07	-1.7837771e+00	*	+1.7432333e-07	-1.7045567e+00	*
B_TIME	-1.4198127e+00	+3.5398797e-01	-4.0109067e+00		+3.5573530e-01	-3.9912055e+00	

Question 4
You have estimated two models. The first model has a generic specification for cost while the second one an alternative specific specification for the same variable. The results are provided below. Based on the model fit results, is the second model significantly better than the first one? Give a motivation for your answer.

Results of the first model

Model:	Multinomial Logit
Number of estimated parameters:	3
Sample size:	2695
Null log-likelihood:	-1868.03
Init log-likelihood:	-1868.03
Final log-likelihood:	-218.682
Likelihood ratio test:	3298.7
Rho-square:	0.882935
Adjusted rho-square:	0.881329
Final gradient norm:	0.000215735
Variance-covariance:	from finite difference hessian

Results of the second model

Model:	Multinomial Logit
Number of estimated parameters:	4
Sample size:	2695
Null log-likelihood:	-1868.03
Init log-likelihood:	-1868.03
Final log-likelihood:	-211.349
Likelihood ratio test:	3313.37
Rho-square:	0.88686
Adjusted rho-square:	0.884719
Final gradient norm:	0.000211087
Variance-covariance:	from finite difference hessian

Question 5
In the context of the Netherlands mode choice case, you hypothesize that women and men do not perceive car travel time in the same way. More specifically you assume that women like driving more than men and you therefore expect them to be less sensible to differences in car travel time than men. How would you model this and how can you implement it in BIOGEME? Suppose that you have estimated the model, how can you know if your hypothesis is justified?

Question 6
You have estimated a Binary Logit model based on the Netherlands mode choice data. The deterministic parts of the utilities are

$$V_{car} = -0.798 - 1.326 \cdot \text{time}_{car} - 0.050 \cdot \text{cost}_{car} \tag{1}$$

$$V_{rail} = -1.326 \cdot \text{time}_{rail} - 0.050 \cdot \text{cost}_{rail}, \tag{2}$$

where time is measured in hours and cost in Guilders.

Compute the probabilities for the choice between a car trip that costs 16− and takes 2 hours and a rail trip that costs 25− and takes 1 hour.

You have also estimated a model with a specific attribute specification for the time attribute. This yielded the following expressions for the deterministic parts of the utilities:

$$V_{car} = 2.43 - 2.262 \cdot \text{time}_{car} - 0.054 \cdot \text{cost}_{car} \tag{3}$$

$$V_{rail} = -0.543 \cdot \text{time}_{rail} - 0.054 \cdot \text{cost}_{rail}, \tag{4}$$

How have this specification change affected the probabilities of the alternatives given above? Make a sensitivity analysis of the probabilities with respect to travel time (consider the interval 0 to 6 hours). Note that the travel time for car is assumed to be the sum of in-vehicle-time and access time, and the rail time is the sum of in-vehicle-time, access and egress time.

Finally, assume that the public transport company decided to increase the fair of rail by 5−. For the trip mentioned above, calculate the disaggregate direct arc elasticity of the probability of choosing PT with respect to cost after the cost increase, using the estimated parameters of the . Interpret your results.

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